

## Sensors for Small Forces

Type 9215A, 9217A, 9217A1

**-0,5 ... 0,5 N to -500 ... 500 N**

These slim sensors are designed for dynamic and quasistatic tensile and compression forces. Depending on the design of the sensor, it is possible to measure small forces in measuring ranges between -0,5 ... 0,5 N to -500 ... 500 N. As a result of the high sensitivity of the integrated measuring element and special constructive measures during force application, the sensors' threshold is less than one millinewton. The sensors have a sealed housing and are designed for use in industry and the laboratory. Installation of the sensors directly into the structure is made possible by the thread on the shaft. Force is applied to the front side.

- 3 calibrated measuring ranges
- Highly sensitive, for forces from 1 mN
- For tensile and compression forces
- Slim design for small sensor distances

### Description

The sensors are based on the piezoelectric measurement principle. The force acting on the highly sensitive transversal measuring element generates a proportional charge at the signal output. The measuring amplifier to be placed downstream (e.g., ICAM Type 5073A...) or process monitoring system (e.g., maXYmos Type 5867B... /5877A...) converts this into a process signal or curve that can be evaluated (e.g., 0 ... 10 V). The slim, pen-like structural shape of the sensor bodies and the force application on the axial tapped hole are important features of these sensors.

### Application

Due to their slim geometry, the sensors are especially suitable for confined spaces, e.g., to simultaneously measure objects that are placed close together.

Due to the special property of the piezoelectric measuring element – almost constant measurement accuracy over a wide force range – the same sensor can be used across a large force spectrum. This advantage is further supported by the possibility of switching between measuring ranges by using appropriate amplifiers (ICAM Type 5073A...). This makes it possible to measure highly diverse parts at the same measuring station. The 'wide range measuring chain' also offers decisive advantages for use in a laboratory, where frequent sensor changes are part of everyday work. In addition, the extremely high overload protection when using the lower measuring ranges means there is no need for costly protective measures.



Type 9215A

Type 9217A/A1

### Application Examples

- Contact measurement on keys, switches, relays, etc.
- Measuring spring characteristics
- Measuring pull-out forces on plug contacts
- Construction of highly sensitive miniature measuring platforms
- Force measurement on installation machines, robots, micro-manipulators, etc.

### Caution

These force sensors are very sensitive measuring instruments. The highest amount of vigilance is required when working with these sensors, as they are not equipped with a mechanical fuse against overload.

## Technical Data

Please note that all technical data and further information in this data sheet is subject to change at any time without prior notice.

|  | Type    | 9215A                 | 9217A                   | 9217A1                  |
|--|---------|-----------------------|-------------------------|-------------------------|
| Measuring range $F_z$                                      | N       | -20 ... 200           | -500 ... 500            |                         |
| Overload $F_z$   | N       | -30/300               | -600/600                |                         |
| Calibrated measuring ranges, $F_z$<br>100%                 | N       | 0 ... 200             | 0 ... 500<br>0 ... -500 | 0 ... 50<br>0 ... -50   |
| 10%  | N       | 0 ... 20              | 0 ... 50<br>0 ... -50   | 0 ... 5<br>0 ... -5     |
| 1%   | N       | 0 ... 2               | 0 ... 5                 | 0 ... 0,5<br>0 ... -0,5 |
| Threshold, $F_z$   | N       | <0.0005               | <0.001                  |                         |
| Sensitivity, $F_z$   | pC/N    | ≈95                   | ≈105                    |                         |
| Linearity, calibrated measuring ranges                     | %FSO    | ≈±1                   |                         | ≈ ±0.3                  |
| Hysteresis, all measuring ranges                           | %FSO    | ≈±1                   |                         |                         |
| Side load <sup>1)</sup> , max., $F_{xy}$                   | N       | 90                    | 50                      |                         |
| Side load sensitivity<br>$F_{x,y} \rightarrow F_z$         | N/N     | ≤±0.05                | ≤±0.02                  |                         |
| Bending moment, max., $M_{x,y}$                            | N·m     | 0.5                   | 1.78                    |                         |
| Sensitivity to bending moment<br>$M_{x,y} \rightarrow F_z$ | N/N·m   | ≤±20                  | ≤±4                     |                         |
| Torque, max., $M_z$  | N·m     | 1.0                   | 1.35                    |                         |
| Rigidity, $c_z$ ( $F_z$ )                                  | N/μm    | ≈100                  | ≈15                     |                         |
| Natural frequency, $f_n$ ( $F_z$ )                         | kHz     | >50                   | >20                     |                         |
| Acceleration sensitivity<br>axial                          | N/g     | <2 · 10 <sup>-3</sup> | <0.035                  |                         |
| radial   | N/g     | <4 · 10 <sup>-4</sup> | <0.0022                 |                         |
| Operating temperature range                                | °C      | -50 ... 180           | -50 ... 150             |                         |
| Temperature coefficient<br>of sensitivity, $F_z$           | %/°C    | ≈<0.04                | ≈<0.04                  |                         |
| Insulation resistance at 20°C                              | Ω       | >10 <sup>13</sup>     |                         |                         |
| Capacity C   | pF      | ≈15                   | ≈45                     |                         |
| Connection   |         | M4x0.35<br>neg.       | KIAG<br>10-32 neg       |                         |
| Protection class<br>(with connected cable)                 | EN60529 | IP65                  |                         |                         |
| Case material  | DIN     | 1.4542                |                         |                         |
| Weight   | g       | 2.5                   | 16                      |                         |
| Tightening torque, max., $M_A$<br>M2                       | N·m     | 0.2                   |                         |                         |
| M3   | N·m     |                       | 0.5                     |                         |
| M5x0,5   | N·m     | 2                     |                         |                         |
| M10x1  | N·m     |                       | 10                      |                         |

<sup>1)</sup> Application of force on the flange level

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**Dimensions**

**Dimensions of Type 9217A**

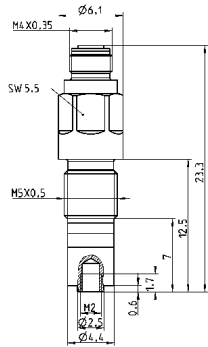


Fig. 1: Dimensions of sensor for small forces Type 9215A

**Dimensions Type 9217A/A1**

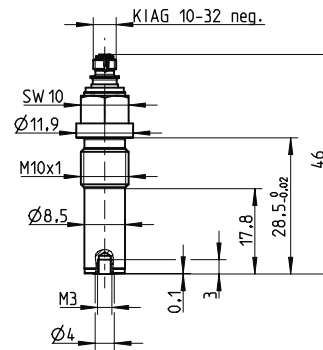


Fig. 2: Dimensions of sensor for small forces Type 9217A/A1

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**Mounting Examples**

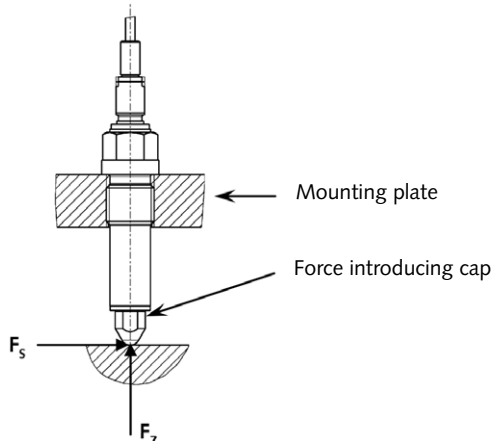


Fig. 3: Force application on force introducing cap

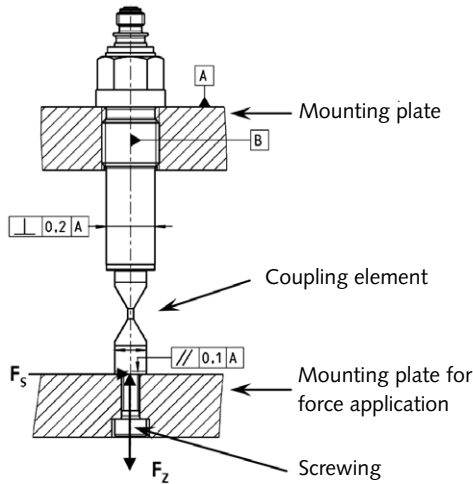


Fig. 4: Mounting with coupling element

**Accessories**

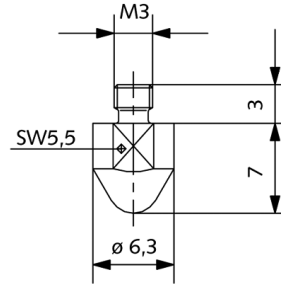


Fig. 5: Force introducing cap Art. No. 3.220.139 for Type 9217A/A1

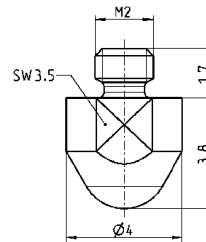


Fig. 6: Force introducing cap Art. No. 3.220.217 for Typ 9215A (included in delivery)

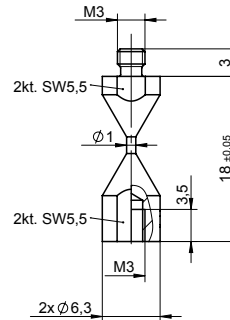


Fig. 7: Coupling element Type 9405 for Type 9217A/A1

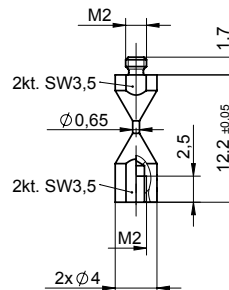


Fig. 8: Coupling element Type 9405A1 for Typ 9215A

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### Optional Accessories

|   | Type         |
|---|--------------|
| • Force introducing cap Type 9217A/A1   | 3.220.139    |
| • Coupling element<br>for Type 9217A/A1   | 9405         |
| • Coupling element<br>for Type 9215A  | 9405A1       |
| • Connecting cable KIAG 10-32 pos. – BNC pos.                                   |              |
| Length 1 m  | 1631C1       |
| Length 2 m  | 1631C2       |
| Length 5 m  | 1631C5       |
| Length 10 m   | 1631C10      |
| • Connecting cable 10-32 pos. – BNC pos., highly flexible                       |              |
| Length 1 m  | 1900A23A1201 |
| Length 2 m  | 1900A23A1202 |
| Length 3 m  | 1900A23A1203 |
| Length 5 m  | 1900A23A1205 |
| Length 10 m   | 1900A23A1210 |
| • Connecting cable M4x0.35 pos. – BNC pos.<br>for Type 9215A                    |              |
| Length 1 m  | 1651C1       |
| Length 2 m  | 1651C2       |
| Length 5 m  | 1651C5       |
| Length 10 m   | 1651C10      |
| • Connecting cable M4x0,35 pos. – BNC pos., highly flexible                     |              |
| Length 1 m  | 1900A23A2201 |
| Length 2 m  | 1900A23A2202 |
| Length 3 m  | 1900A23A2203 |
| Length 5 m  | 1900A23A2205 |
| Length 10 m   | 1900A23A2210 |
| • Coupling<br>for Type 9217A/A1<br>KIAG 10-32 neg. – KIAG 10-32 neg.            | 1729A        |
| • Angle coupling<br>for Type 9217A/A1<br>KIAG 10-32 pos. int. – KIAG 10-32 neg. | 1700A29      |
| • Cleaning and insulation spray 250 ml  | 1003         |
| • Insulation testing device   | 5493         |

For connection, extension, and connecting cables, see data sheet for Cables for Force, Torque, and Strain Sensors (1631C\_000-346).

For cable connectors, couplings, and accessories, see data sheet for Coaxial Cable Connectors (1700\_000-347).

### Ordering Code

|  | Type          |
|--|---------------|
| • Sensor for small forces<br>M5x0.5, axial connection, -20 ... 200 N                         | <b>9215A</b>  |
| • Sensor for small tensile and compression forces<br>M10x1, axial connection, -500 ... 500 N | <b>9217A</b>  |
| • Sensor for small tensile and compression forces<br>M10x1, axial connection, -50 ... 50 N   | <b>9217A1</b> |